CHAPTER 6

Metropolitan Area Trends

While most of this report discusses air quality trends on a national scale, there is great interest in local air quality trends. This chapter presents trends in criteria pollutants for Metropolitan Statistical Areas (MSAs) in the United States. Table A-16 gives the 1995 peak statistics for all MSAs, providing a snapshot of the most recent year. Ten-year trends are shown for the 255 MSAs having adequate data. Table A-17 lists these MSAs and reports criteria pollutant trends as significant upward or downward, or not significant, based on a statistical analysis described in the following section. Another way to assess trends in MSAs is to examine the Pollutant Standards Index (PSI) value.[1,2] Tables A-18 and A-19 list the number of days with PSI values greater than 100 for the nation's 94 largest metropolitan areas. A discussion of the PSI analysis rounds out this chapter on MSA trends.

Metropolitan Statistical Area Trends Analysis

The focus of this analysis is on examining 10-year air quality trends for MSAs. The data used for this analysis are based on pollutant concentrations from the subset of ambient monitoring sites that meet the same trends criteria set forth in Appendix B. A total of 255 MSAs had at least one monitoring site meeting these criteria. Note that some pollutants are not considered a problem in some MSAs. Therefore, no ongoing efforts exist to monitor these pollutants in these areas. Consequently, not all pollutants are represented in every MSA.

For each of the 10 years between 1986 and 1995, and for each pollutant with available data, spatial averages were obtained for each of the 255 MSAs by averaging all monitoring data in their respective MSA. This process resulted in one value per MSA per year for each pollutant. While there are seasonal aspects of certain pollutants and, therefore, seasonality in monitoring intensity among MSAs, these averages provide a consistent year to year value with which to assess trends. To test for statistically significant trends, a linear regression was applied to these data. Since the underlying pollutant distributions cannot always be assumed normal, the regression analysis was based upon a nonparametric method, commonly referred to as the Theil test.[3,4,5] Because this method bases statistical significance on changes during the entire 10-year period, it is possible to detect an upward or downward trend even when the concentration level of the first year equals the concentration level of the last year. Because this method uses a median estimator, it is not influenced by single extreme values.

Table 6-1 summarizes the trends analysis performed on the 255 MSAs. It shows that there were no upward trends in CO, lead, and PM-10 (annual mean) at any of the MSAs over the past decade. Of the 225 MSAs, 204 had downward trends in at least one of the criteria pollutants, and only 16 had upward trends. A closer look at these 16 MSAs reveals that all but one is well below the NAAQS for the respective pollutant, meaning that their upward trends are not immediately in danger of violating the NAAQS. These results demonstrate significant improvements in urban air quality over the past decade.

The Pollutant Standards Index

PSI values are derived from pollutant concentrations. They are reported daily in all metropolitan areas of the United States with

Table 6-1. *Summary of MSA Trend Analysis, by Pollutant*

		Total # MSAs	# MSAs UP	# MSAs DOWN	# MSAs with No Significant Change
CO	Second Max, 8-Hour	139	0	102	37
Pb	Max Quarterly Mean	94	0	84	10
NO_2	Annual Arithmetic Mean	86	1	44	41
O_3	Second Daily Max, 1-Hour	183	4	43	136
PM-10	Second Max, 24-Hour	221	3	55	163
PM-10	Weighted Annual Mean	221	0	108	113
SO_2	Second Max, 24-Hour	144	3	77	64
SO_2	Annual Arithmetic Mean	144	7	90	47

populations exceeding 200,000 and are used to assess air quality over large urban areas. The PSI is usually reported as a number (between 0 and 500) or a word (e.g., "unhealthful") and is featured on local TV or radio news programs and in newspapers.

The Pollutant Standards Index (PSI) is computed for PM-10, SO_2, CO, O_3, and NO_2 and is based on their short-term National Ambient Air Quality Standards (NAAQS), Federal Episode Criteria, and Significant Harm Levels. Lead is the only criteria pollutant not included in the index because it does not have a short-term NAAQS, a Federal Episode Criteria, or a Significant Harm Level. The five PSI color categories and their respective health effect descriptors are listed in Table 6-2.

The PSI integrates information on criteria pollutant concentrations across an entire monitoring network into a single number that represents the worst daily air quality experienced in an urban area. For each of the criteria pollutants, concentrations are converted into an index value between 0 and 500. The pollutant with the highest index value is reported as the PSI for that day. Therefore, the PSI does not take into account the possible adverse effects associated with combinations of pollutants (i.e. synergism).[1,2]

A PSI value of 100 corresponds to the standard established under the Clean Air Act (CAA), and a PSI value greater than 100 indicates that at least one criteria pollutant exceeded air quality standards on a given day; therefore, air quality would be in the unhealthful range on that day. Relatively high PSI values activate public health warnings. For example, a PSI of 200 initiates a First Stage Alert at which time sensitive populations (the elderly and persons with respiratory illnesses) are advised to remain indoors and reduce physical activity. A PSI of 300 initiates a Second Stage Alert at which time the general public is advised to avoid outdoor activity.

Summary of PSI Analyses

Of the five criteria pollutants used to calculate PSI, CO, O_3, PM-10, and SO_2 generally contribute to the PSI value. Nitrogen dioxide is rarely the highest pollutant measured because it does not have a short-term NAAQS and can only be included when concentrations exceed one of the Federal Episode Criteria or Significant Harm Levels. Ten-year PSI trends are based on daily maximum pollutant concentrations from the subset of ambient monitoring sites that have complete data for a minimum of eight out of the 10 years.

Since a PSI value greater than 100 indicates that the level of the NAAQS for at least one criteria pollutant has been exceeded on a given day, the number of days with PSI values greater than 100 provides an indicator of air quality in urban areas. Figure 6-1 shows the trend in the

Table 6-2. *Pollutant Standards Index Values with Pollutant Concentration, Health Descriptors, and PSI Colors*

INDEX VALUE	AIR QUALITY LEVEL	POLLUTANT LEVELS PM-10 (24-hour) ug/m³	SO_2 (24-hour) ug/m³	CO (8-hour) ppm	O_3 (1-hour) ppm	NO_2 (1-hour) ppm	HEALTH EFFECT DESCRIPTOR	PSI COLORS
500	SIGNIFICANT HARM	600	2,620	50	0.6	2.0		
400	EMERGENCY	500	2,100	40	0.5	1.6	HAZARDOUS	RED
300	WARNING	420	1,600	30	0.4	1.2		
							VERY UNHEALTHFUL	ORANGE
200	ALERT	350	800	15	0.2	0.6		
							UNHEALTHFUL	YELLOW
100	NAAQS	150	365	9	0.12	a		
							MODERATE	GREEN
50	50% OF NAAQS	50	80[b]	4.5	0.06	a		
							GOOD	BLUE
0		0	0	0	0	a		

[a] No index values reported at concentration levels below those specified by "Alert Level" criteria.
[b] Annual primary NAAQS.

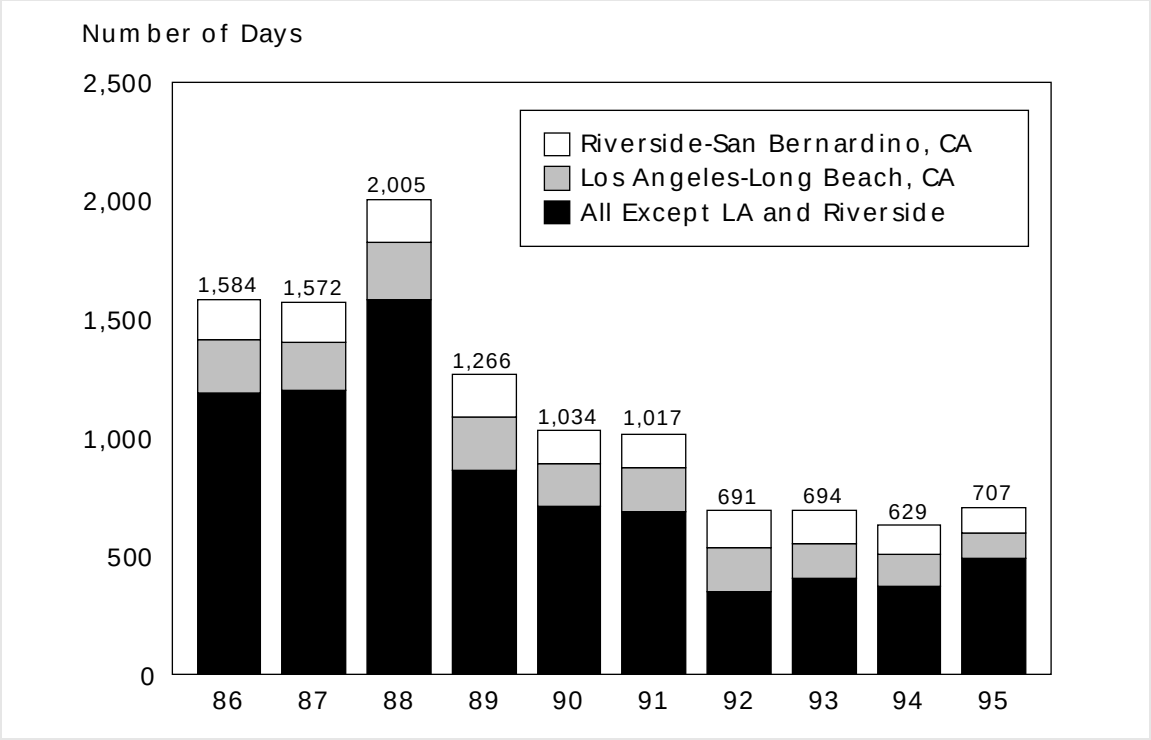

Figure 6-1. *Number of days with PSI values > 100, 1986–1995.*

number of days with PSI values greater than 100 summed across the nation's 94 largest metropolitan areas (those cities with total 1990 population greater than 500,000). Because of their magnitude, PSI totals for Los Angeles, CA and Riverside, CA are shown separately. The long-term air quality improvement in urban areas is evident in this figure. Between 1986 and 1995, the total number of days with PSI values greater than 100 decreased 54 percent in Los Angeles, 35 percent in Riverside, and 58 percent in the remaining major cities across the United States.

PSI estimates depend on the number of pollutants monitored as well as the number of monitoring sites where data are collected. The more pollutants and sites that are available in an area, the better the estimate of the maximum PSI for a given day. Ozone accounts for the majority of days with PSI values above 100, but is collected at only a small number of sites in each area. Table A-20 shows that the percentage of days with PSI values greater than 100 attributed to ozone has increased from 67 percent in 1986 to 92 percent in 1995. This increase reveals a clear trend that ozone increasingly accounts for those days above the 100 level and reflects the success in achieving lower CO and PM-10 concentrations. However, the typical one-in-six day sampling schedule for most PM-10 sites limits the number of days that PM-10 can factor into the PSI determination.

References

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